Premises

Autonomous Systems
Sistemi Autonomi

Andrea Omicini
andrea.omicini@unibo.it

Dipartimento di Informatica – Scienza e Ingegneria (DISI)
Alma Mater Studiorum – Università di Bologna

Academic Year 2015/2016

1. Machines
2. Artificial Systems
3. Questions

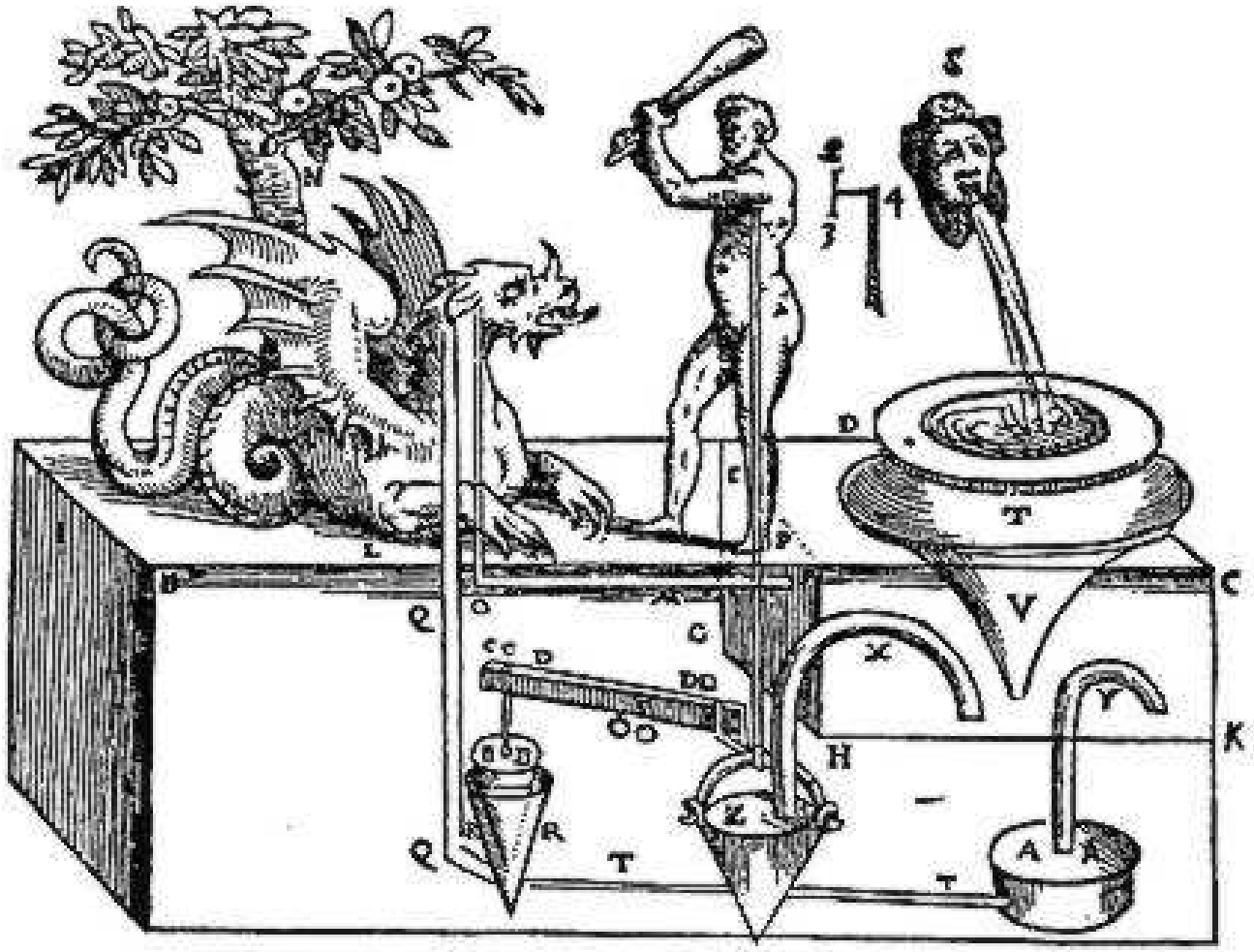
Outline

1 Machines

2 Artificial Systems

3 Questions

The Obsession with (Autonomous) Machines I



The Obsession with (Autonomous) Machines II

Machines doing something "by themselves"

- An obsession coming with *technique*
  - basically, representing our way to *affect* the world around us
  - possibly, according to our *goals*
- China, Greece, Italy, England, France
  - hundred years of attempts, and some success, too

The Obsession with (Autonomous) Machines III

The Obsession with (Autonomous) Machines IV

The Obsession with (Autonomous) Machines V

Are just humans "playing God"?

- Maybe, ok, good point.
- Fascination was so huge, too
- So strong, that *fake* automata were even quite frequent, and even famous

The Obsession with (Autonomous) Machines VI

The Obsession with (Autonomous) Machines VII

The original question

- What can human *artefacts* actually *do*?
- What can they *achieve*?
- What can humans *achieve* with the systems they create?

Before Autonomous Systems: Machines I

Constructing for understanding

- Building machines with
  - initiative
  - autonomy
  - knowledge

  for *understanding ourselves*, and the *world* where we live
- "Playing God" to understand the world

Before Autonomous Systems: Machines II

Relieving humans from fatigue

- Goal: *substituting human* work in
  - quality
  - quantity
  - cost
  - speed
- More, better, cheaper work done
  - new activities become feasible
- Which work?
  - first, *physical*
  - then, *repetitive*, enduring
  - subsequently, *intellectual*, too
  - finally, simply more *complex* for any reason—or, all reasons together

Before Autonomous Systems: Machines III

Some steps beyond

- *Delegating* human *functions* to machines
  - within already existing social structures, organisations, and processes
- Creating *new functions*
  - then, making new social structures, organisations, and processes possible
  - example: steam engines on wheels
- Essentially, changing the world we live in

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Machines & Artificial Systems I

Systems and machines

- We call *systems* what many years ago we simply called *machines*
- Complexity has grown, and we understand the many levels at which systems, their components, their mutual relationships can be understood
- Furthermore, at the right level of abstraction, HW / SW systems are machines in the same acceptation as mechanical machines
- In the following, we will mostly used two non-strictly coherent, but simple notions
  - system as a *primitive notion* (which somehow we all share to a certain extent)
  - system as an *engineer-designed entity* ("draw a line around what you call a 'system'")

Machines & Artificial Systems II

Artificial systems

- Here we mostly talk about artificial systems in general
- Systems either partially or totally *designed by humans*
  - either directly or indirectly
  - ? systems designed by systems?

  featuring
  - a *goal* (in the mind of the designer)
  - a *function* (in the body of the system)

  and implicitly consider the computational part as an essential one
- An artificial system, roughly speaking, is any sort of system which humans put at work by assigning it a function in order to achieve some goal

Which Sorts of Systems? I

Artificial and computational systems

- Nowadays, most (if not all) artificial systems nowadays have a prominent *computational* part
  - For this and other obvious reasons, here we focus on that sort of systems
- Computational machines
  - have both an abstract and a physical part
    - where the physical portions are often abstracted away
  - are (mostly) symbolic
    - can deal with math, logic, data, information, knowledge
  - are general-purpose machines
    - programmable, can be specialised to most purposes

Which Sorts of Systems? II

Artificial systems in context

- Most artificial systems *participate* to the activities of individuals, groups and societies
- Even more, nowadays they are mostly essential to all sorts of human activities

Socio-technical systems [Whi06]

- Artificial systems where both *humans* and *artificial* components play the role of system components
  - from online reservation systems to social networks
- Most of nowadays systems are just socio-technical systems
  - or, at least, cannot be engineering and successfully put to work without a proper socio-technical perspective in the engineering stage

Which Sorts of Systems? III

Pervasive systems

- Affecting every aspects of our everyday life
- By spreading through the whole environment where we live and act
- We live surrounded by *pervasive systems*

Situated systems

- The *physical* nature of artificial components cannot be always be forgot
- As well as the situatedness in *time* and *space*
- Along with the influence of the surrounding *environment*
- Most of the interesting systems, nowadays, are *situated systems*, too

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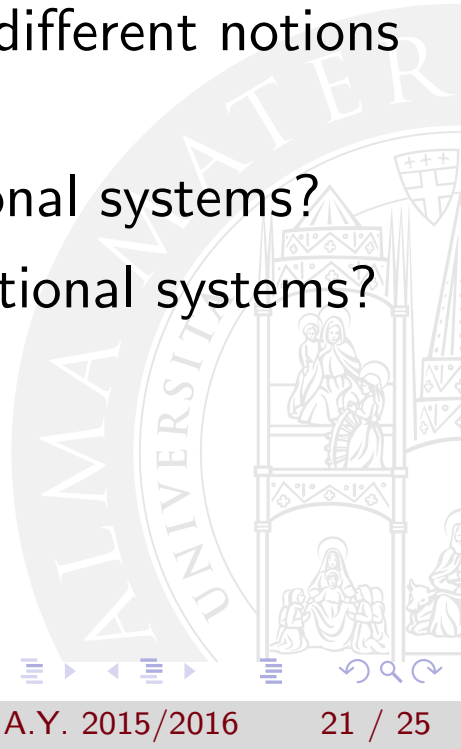
What about Autonomy?

- Which is the role of autonomy in the systems of that sort?
  - from online reservation systems to social networks
- What is autonomy there?
- Is there just one single notion of autonomy, or, many different notions may play diverse roles?
- How do we *model* autonomy in artificial / computational systems?
- How do we *engineer* autonomy in artificial / computational systems?



What about Responsibility?

- Who is responsible for autonomous systems?
  - no longer just an issue for, say, civil, mechanical, or chemical engineers
  - for instance, who would be responsible for a home robot killing its owners?
- Do we need Asimov's Laws of Robotics? [Asi50]
- Would this be possible / enough?
- What about Crichton's nanoswarms in Prey? [Cri02]
- How do we define autonomy, systems, and responsibility *altogether*?

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